(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 350 179 A1**

# (12) EUROPEAN PATENT APPLICATION

(21) Application number: 89306256.2

(51) Int. Cl.4: G06K 19/06 , B29C 67/24

(22) Date of filing: 21.06.89

(30) Priority: 21.06.88 GB 8814664
19.01.89 GB 8901189

(43) Date of publication of application:
10.01.90 Bulletin 90/02

(84) Designated Contracting States:
AT BE CH DE ES FR GB GR IT LI LU NL SE

(71) Applicant: W. & T. AVERY LIMITED
Smethwick
Warley, West Midlands B66 2LP(GB)

(72) Inventor: Jarvis, Charles Richard
Mill View 39 Barbrook Lane
Tiptree Essex(GB)

(74) Representative: Loven, Keith James et al
GEC plc Patent Dept.(Chelmsford Office)
GEC-Marconi Research Centre West
Hanningfield Road
Great Baddow Essex CM2 8HN(GB)

## (54) Manufacturing portable electronic tokens.

(57) A small article such as portable electronic token of the smart card type is manufactured by means of a reaction injection moulding technique in which electronic circuitry (1,2) is encapsulated within a hardenable plastics material (8). The labels on the faces of the card (6) are used as a mould release agent to enable easy release of the token, once hardened, from the mould (10). The articles are conveniently manufactured by a continuous process using moving belts.

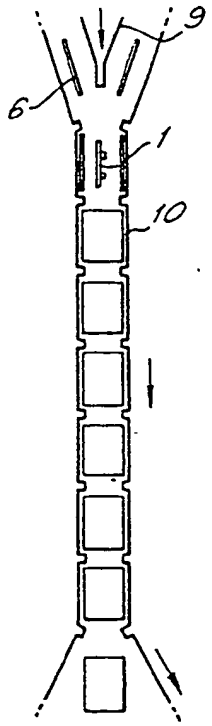


FIG. 2.

EP 0 350 179 A1

# MANUFACTURING PORTABLE ELECTRONIC TOKENS

This invention relates to manufacturing portable electronic tokens and in particular, but not exclusively, it relates to the manufacture of small, portable, articles which include an electronic circuit encapsulated within a plastics material, such as an electronic token of the "smart card" type.

Injection moulding is often used as a method of manufacturing small plastic articles. In such methods, usually small granules of the plastics material are heated so as to melt the material and the resulting fluid is injected at high temperature and pressure, perhaps 300°C and 2,00 PSI into a mould of a desired shape. The material is then allowed to set in the mould as it cools.

Such a method is fine for the manufacture of small, homogeneous, articles. However, articles such as those commonly known as "smart cards" which comprises a number of components such as electronic circuits, input/output interfaces, substrates and labels are less well suited to the process since the high pressures and temperatures involved tend to displace inserts and indeed can damage the functioning thereof. Smart cards are generally manufactured by a lamination process.

The present invention seeks to provide an improved moulding technique for such articles.

According to the present invention there is provided a method of manufacturing portable electronic tokens comprising one or more electronic components and data input/output means encapsulated within a plastics body and high tensile modulus members disposed as skins on at least two opposing main faces of the body and having graphics thereon; which method comprises locating the high tensile members against the side of a mould, locating the components between the members, injecting a reaction injection mouldable plastics material into the mould such that it encapsulates the components but is prevented, by the members, from contacting the surface of the mould, allowing the material to harden, and, removing the token from the mould.

Preferably, the articles are electronic tokens of the "smart card" type and have credit card sized dimensions, typically 8.5 by 5.4 by 0.075 cm. They may be of the type which use contactless coupling by means of an inductive loop, encapsulated within the plastics or resin material. In one embodiment, the portions of the token are co-extruded. The mould may comprise two endless belts which are located to cooperate in use to form a continuously moving mould cavity.

In an alternative embodiment, the high tensile members are arranged in two continuous sheets and are transported through the moulds, carrying the components and plastics material; the individual tokens being subsequently separated after hardening.

Preferably, after the components and plastics material have been introduced between the members, the edges of the members are sealed to form a sealed structure within which the plastics material is allowed to harden. To protect the graphics on the labels or skins, the graphics may be printed or otherwise deposited on their inner surface, i.e. the surface contacting the plastics material. The provision of the skins serves both to strengthen a card, as the skin is of a sufficiently high tensile modulus as to make a card substantially rigid but flexible, typically of similar flexibility and rigidity to a standard laminated credit card, and also serves as a mould release agent since the plastics material, which may for example be an epoxy, has an adhesive nature and thus problems can arise if this contacts the mould and adheres to it.

Any plastics material or mixture may be used which has the capability of hardening under a reaction injection moulding (RIM) process.

An embodiment of the invention will now be described by way of example only with reference to the accompanying Figures in which;

Figure 1 shows schematically the cross section of an electronic token when manufactured by a method embodying the present invention, and;

Figures 2 and 3 show schematically manufacturing processes.

Referring to Figure 1, the token or card incorporates one or more integrated circuits 1 and capacitors 2. Rigid inserts 3, which may be made of strong metal or a rigid moulded compound, surround the circuits and capacitors so as to provide strengthening and to resist damage caused by flexing the card. The power and input/output requirements of such a card are achieved by means of inductive coils 4 mounted on a substrate 5 and disposed generally around the periphery of the card. Printed labels 6 are positioned on the face of the card. These labels are made of polyester, polycarbonate, polyimide or a material of a similar tensile modulus and, in addition to their function as labels, also have a strengthening effect due to a 'double-skinned' effect. Without the labels the cards might be flaccid and their functions would probably be impaired. The printing is preferably on the inner surface 6a of the label to protect it. The electronic components within the card are interconnected by means of for example copper layers 7. The remainder of the material of the card is made from a moulded plastics or resin material such as polyurethane 8 or epoxy.

The card is assembled by means of a moulding process known as reaction injection moulding (RIM). This is a well known process which is often used in the manufacture of large plastics articles such as car bumpers, surfboards and the like. The difference from conventional injection moulding techniques is that two materials are used which are combined immediately before moulding. These are a resin and a hardener, which, when combined together harden within a fixed time period which is dependent upon the constituents. With conventional injection moulding, heat and pressure are required to melt the resin and inject it into a mould, whereupon the resin sets as it cools. RIM is characterised by the fact that since the resin and hardener mixture is a liquid at a low temperature then high pressure and temperatures are not required.

In a first embodiment of the present invention the components of the card, other than the molten plastics material are fixed in place within a mould such that the labels are adjacent the sides of the mould, printed surface inward, and the other components lie between the labels. The resin is then added at a low pressure and temperature. Since the resin is in a fluid state, typically having the consistency of for example milk or thin cream, then the resin flows throughout the mould, making good contact with all the components and eventually completely covering and encapsulating them. It then begins to set after the fixed time period, perhaps two to ten minutes, although resins are available which can begin to set after a few seconds. After the resin has set then the complete token is removed from the mould and the process can be repeated.

Since the resin is not allowed to contact the mould walls the labels act as a release from the mould cavity walls.

In order to speed up the production rate the preprinted labels and components can be fed into a die which is also supplied with RIM fluid resin from a nozzle. This is shown in Figure 2 (which is not to scale), in which the die consists of a plurality of cavities 10 formed by two recessed endless belts running back to back to form a continuously moving mould cavity, moving in the direction shown by the arrows. The labels 6 and components 1 are fed into each moving cavity and the resin fed in through a nozzle 9. The components, labels and fluid, in the required configuration are then coextruded from the die to form continuous strips of completed cards, which subsequently set and are then separated as desired.

Figure 3 shows an alternative process in which the labels 6 are arranged in two continuous sheets which are spooled through a static mould 11. The resin and components are applied to the labels in the same relative disposition as that of Figure 2 and are transported through the mould with the labels, setting and hardening as they move. Preferably, 2 pairs of opposing pinch rollers, 12 and 13 are brought together periodically to pinch together and seal the ends of each label. The rollers are then withdrawn until the labels have moved, in the direction of the arrow, a sufficient distance for the next pair of labels to be adjacent the rollers, and so on.

## Claims

1. A method of manufacturing portable electronic tokens comprising one or more electronic components and data input/output means encapsulated within a plastics body and high tensile modulus members disposed as skins on at least two opposing main faces of the body and having graphics thereon; which method comprises locating the high tensile members, against the side of a mould, locating the components between the members, injecting a reaction injection mouldable plastics material into the mould such that it encapsulates the components but is prevented, by the members, from contacting the surface of the mould, allowing the material to harden, and, removing the token from the mould.

2. A method as claimed in Claim 1 wherein the tokens are smart cards.

3. A method as claimed in Claim 1 wherein the portions of the token are co-extruded.

4. A method as claimed in Claim 1 or Claim 2 wherein the mould comprises two endless belts which are located to cooperate in use to form a continuously moving mould cavity.

5. A method as claimed in Claim 1 or Claim 2 wherein the high tensile members are arranged in two continuous sheets and are transported through the moulds carrying the components and plastics material; the individual tokens being subsequently separated after hardening.

6. A method as claimed in Claim 5 wherein after the components and plastics material have been introduced between the members, the edges of the members are sealed to form a sealed structure within which the plastics material is allowed to harden.

7. A method as claimed in Claim 6 wherein pinch rollers are used to seal the edges of the members.

8. A method as claimed in any of the preceding claims wherein the graphics on the members are deposited on their inner surfaces.

9. A portable electronic token manufactured by the method of any of Claims 1 to 8.

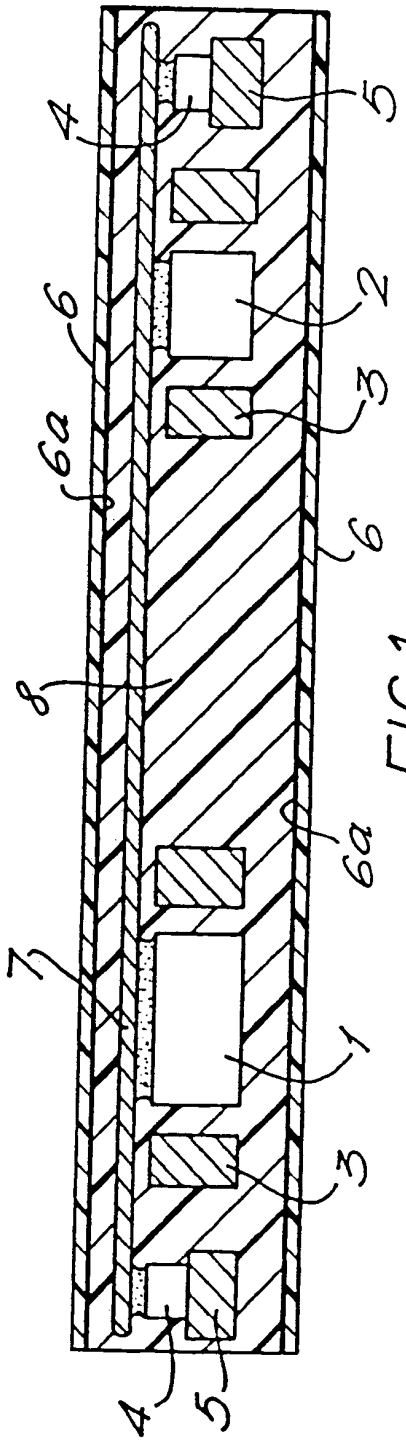


FIG.1.

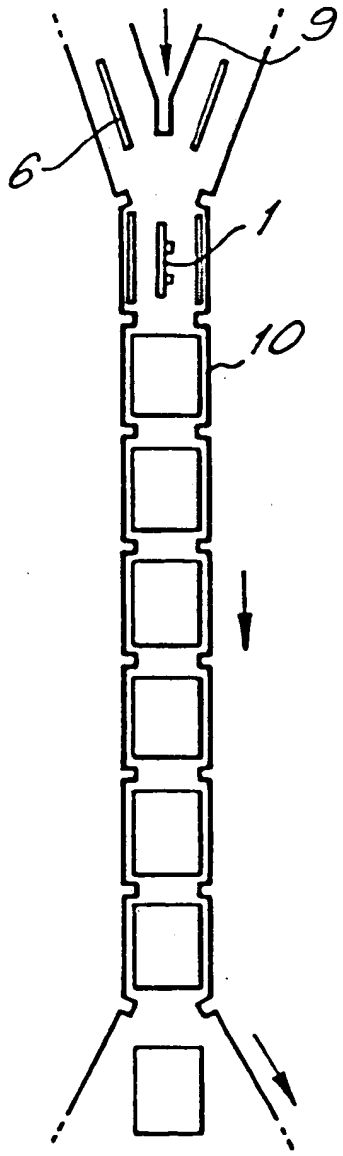


FIG. 2.

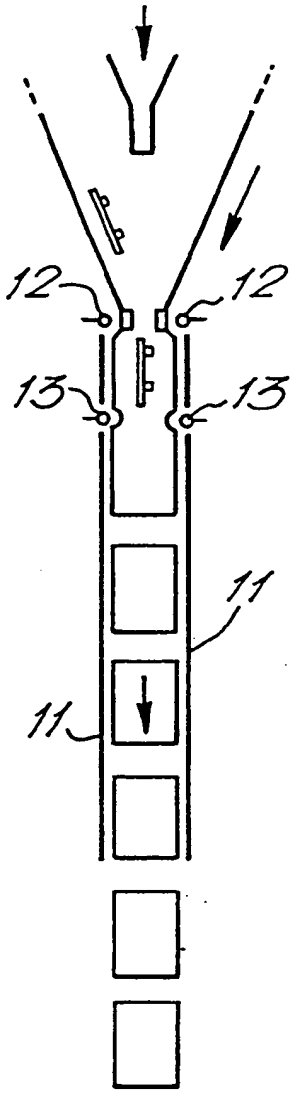


FIG. 3.

European Patent Office

# EUROPEAN SEARCH REPORT

Application Number

EP 89 30 6256

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int. Cl.4) |
|---|---|---|---|
| X | RESEARCH DISCLOSURE, no. 290, June 1988, page 418, abstract no. 29089, New York, NY, US; "Integrated circuit encapsulation by reaction injection molding" * Abstract * --- | 1-3,8,9 | G 06 K 19/06<br>B 29 C 67/24 |
| Y | IDEM --- | 4-7 | |
| X<br>Y | EP-A-0 071 255 (SIEMENS AG) * Page 11, line 18 * --- | 1-3,8,9<br>4-6,7 | |
| Y | EP-A-0 134 820 (MELZER et al.) --- | 4,5 | |
| Y | US-A-4 214 936 (BIANCO) --- | 6,7 | |
| A | EP-A-0 246 744 (K.K. TOSHIBA) --- | 1-9 | |
| A | GB-A-2 081 974 (GAO GESELLSCHAFT) --- | 1-9 | |
| A | GB-A- 588 658 (ICI LTD) --- | 1-9 | TECHNICAL FIELDS SEARCHED (Int. Cl.4) |
| A | EP-A-0 041 642 (DU PONT DE NEMOURS) --- | 1-9 | G 06 K<br>B 29 C |
| A | IBM TECHNICAL DISCLOSURE BULLETIN, vol. 28, no. 11, April 1986, pages 4723-4725, New York, US; "Stiffened card with integrated circuit" ----- | | |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 27-09-1989 | ROBERTS P.J. |

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P0401)